UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/935,255	08/22/2001	Ronald A. Weimer	MTI-31529	1208

31870 7590 10/15/2010

WHYTE HIRSCHBOECK DUDEK S.C.
INTELLECTUAL PROPERTY DEPARTMENT
555 EAST WELLS STREET, SUITE 1900
MILWAUKEE, WI 53202

EXAMINER
CHEN, JACK S J

ART UNIT	PAPER NUMBER
2893	

NOTIFICATION DATE	DELIVERY MODE
10/15/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

jpolmatier@whdlaw.com

Office Action Summary	Application No.	Applicant(s)	
	09/935,255	WEIMER, RONALD A.	
	Examiner	Art Unit	
	Jack Chen	2893	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 July 2010*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5,7-57,73,75-81,96 and 98-121* is/are pending in the application.

4a) Of the above claim(s) *15,22-57,73,75-81,83-96,101,102 and 107-111* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,7-14,16-21,98-100,103-106 and 112* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *7/30/2010*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim status

1) Claims canceled: 6, 58-72, 74, 82 and 97

2) Claims pending: 1-5, 7-57, 73, 75-81, 96 and 98-121

3) Claims withdrawn from further consideration: 15, 22-57, 73, 75-81, 83-96, 101, 102, 107-111 and 113-121

4) **Claims Active: 1-5, 7-14, 16-21, 98-100, 103-106 and 112**

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1, 5, 7, 8, 18, 98-100, 103 and 106 are rejected under 35 U.S.C. 102(b) as being anticipated by Aronowitz et al., US/6,087,229.

Re claims 1, 5, 8 Aronowitz et al. discloses a method of forming a nitride barrier layer, comprising the steps of: exposing/irradiating a dielectric material 204 to a silicon-containing gas under low partial pressure (layer 206 in fig. 2C is formed by exposure of an oxide layer to a silicon gas under low partial pressure and high vacuum --because low-pressure CVD (LPCVD) is used-- to form a silicon layer 206) to deposit/nucleate a continuous layer of silicon 206 over the dielectric material (fig. 2C); and exposing the silicon layer to a nitrogen-containing gas to nitridize the silicon layer to form a continuous silicon nitride dopant diffusion barrier layer 206

over the dielectric material effective to inhibit passage of a dopant (note: this is the intrinsic properties of the nitride material, also see col. 8, first paragraph and lines 27-34; further in this regard, the intrinsic properties of the nitride material is evidence by Sugita et al., US/6,998,303, col. 2, lines 60-66) therethrough into the dielectric material (fig. 2D), the dopant diffusion barrier layer consisting of silicon and nitrogen overlying and interfacing with the dielectric material (i.e., SiN, see fig. 2D), see figs. 1A-5D and cols. 1-10 for more details. Furthermore, the term "effective" is a relative term, therefore, the instant method for forming the SiN is considered as "effective" and the phrase "effective to inhibit passage of a dopant therethrough" can also be considered as functional language and/or intended used limitation in the method claim(s).

Re claim 7, Aronowitz et al. discloses a method of forming a nitride barrier layer, comprising the steps of: exposing/irradiating a dielectric material 204 to a silicon-containing gas under low partial pressure (layer 206 in fig. 2C is formed by exposure of an oxide layer to a silicon gas under low partial pressure and high vacuum --because low-pressure CVD (LPCVD) is used-- to form a silicon layer 206) to deposit/nucleate a continuous layer of silicon 206 over the dielectric material (fig. 2C); and nitridizing the silicon layer in a nitrogen-containing gas to form a continuous silicon nitride dopant diffusion barrier layer 206 (fig. 2D) effective to inhibit passage of a dopant (note: this is the intrinsic properties of the nitride material, also see col. 8, first paragraph and lines 27-34; further in this regard, the intrinsic properties of the nitride material is evidence by Sugita et al., US/6,998,303, col. 2, lines 60-66) therethrogh into the dielectric material, the dopant diffusion barrier layer consisting of silicon and nitrogen overlying and interfacing with the dielectric material (i.e., SiN, see fig. 2D), see figs. 1A-5D and cols. 1-10 for more details. Furthermore, the term "effective" is a relative term, therefore, the instant

method for forming the SiN is considered as "effective" and the phrase "effective to inhibit passage of a dopant therethrough" can also be considered as functional language and/or intended used limitation in the method claim(s).

Re claim 18, Aronowitz et al. discloses a method of forming a nitride barrier layer, comprising the steps of: depositing a continuous silicon layer 206 onto a dielectric material 204 (fig. 2C) by exposing the dielectric material 204 to a silicon-containing gas under low partial pressure (layer 206 in fig. 2C is formed by exposure of an oxide layer to a silicon gas under low partial pressure and high vacuum --because low-pressure CVD (LPCVD) is used-- to form a silicon layer 206) and thermally annealing/nitridized the silicon layer in a nitrogen-containing gas to form the nitride dopant diffusion barrier layer, said barrier layer effective to inhibit passage of a dopant (note: this is the intrinsic properties of the nitride material, also see col. 8, first paragraph and lines 27-34; further in this regard, the intrinsic properties of the nitride material is evidence by Sugita et al., US/6,998,303, col. 2, lines 60-66) into the dielectric material, the dopant diffusion barrier layer consisting of silicon and nitrogen overlying and interfacing with the dielectric material (i.e., SiN, see fig. 2D), see figs. 1A-5D and cols. 1-10 for more details. Furthermore, the term "effective" is a relative term, therefore, the instant method for forming the SiN is considered as "effective" and the phrase "effective to inhibit passage of a dopant therethrough" can also be considered as functional language and/or intended used limitation in the method claim(s).

Re claim 98, wherein the silicon-containing gas is selected from the group consisting of dichlorosilane, silicon tetrachloride, silane, and disilane (i.e., silane, col. 5, lines 45-46).

Re claim 99, wherein the step of exposing the dielectric material to the silicon gas comprises chemical vapor deposition of the silicon gas (col. 5, lines 44-55).

Re claim 100, wherein the step of exposing the dielectric material to the silicon gas comprises rapid thermal chemical vapor deposition of the silicon gas (col. 5, lines 44-55, i.e., the deposition rate shown in the prior art is considered as rapid).

Re claim 103, wherein the step of exposing the silicon layer comprises thermally annealing/nitridization the silicon layer in a nitrogen-containing gas (col. 5-6).

Re claim 106, wherein the nitrogen-containing gas is selected from the group consisting of nitrogen, ammonia, nitrogen trifluoride, nitrogen oxide, and a nitrogen-helium mixture (i.e., N2, col. 6, lines 25-30).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later

invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 2-4, 9-14, 16-17, 19-21, 104-105 and 112 are rejected under 35 U.S.C. 103(a) as being unpatentable over Aronowitz et al., US/6,087,229 in view of Muralidhar et al., U.S./6,297,095 B1.

With respect to claims 2-4, 9-14, 16-17, 19, 104 and 112; Aronowitz is silent to the claimed conditions, such as pressure, temperature, during/time as shown in the instant claims.

Muralidhar discloses a method of forming the similar nitride barrier layer having the claimed process parameters (i.e., pressure, temperature and/or time/duration), comprising the steps of: exposing a dielectric material 14/102 to a silicon-containing gas under low partial pressure to deposit a layer of silicon 15/16/17/18/19/21/103/104 (figs. 6-10, 21-22, col. 10, lines 25-65) over the dielectric material; and exposing the silicon layer to a nitrogen-containing gas to nitridize the silicon layer to form a continuous silicon nitride barrier layer 106/107 (figs. 23-25; col. 16, lines 19-36) over the dielectric material effective to inhibit passage of a dopant (note: inherently shows this because this is the intrinsic properties of the nitride material) into the dielectric material, see figs. 1-28 and cols. 1-22 for more details.

Re claim 2, wherein the dielectric material is exposed to the silicon-containing gas at a partial pressure of about 10^{-2} Torr or less (col. 11, lines 37-50).

Re claim 3, wherein the dielectric material is exposed to the silicon-containing gas at a partial pressure of about 10^{-2} to about 10^{-7} Torr (col. 11, lines 37-50).

Re claim 4, wherein the dielectric material is exposed to the silicon-containing gas at a temperature of about 500^{O}C to about 700^{O}C (col. 10, lines 35-58).

Re claim 9, a method of forming a nitride barrier layer, comprising the steps of: exposing a dielectric material 14/102 to a silicon-containing gas at a partial pressure of about 10^{-2} Torr or less (col. 11, lines 37-50) to deposit a layer of silicon 15/16/17/18/19/21/103/104 thereon; and nitridizing the silicon layer to form a continuous silicon nitride barrier layer 106/107 (figs. 23-25; col. 16, lines 19-36) effective to inhibit passage of a dopant (note: inherently shows this because this is the intrinsic properties of the nitride material) into the dielectric material, see figs. 1-28 and cols. 1-22 for more details.

Re claim 10, wherein the dielectric material is exposed to the silicon-containing gas at a temperature of about 500^{O}C to about 700^{O}C (col. 10, lines 35-58).

Re claim 11, wherein the silicon-containing gas is selected from the group consisting of dichlorosilane, silicon tetrachloride, silane, and disilane (col. 10, lines 25-35).

Re claim 12, wherein exposing the dielectric material to the silicon-containing gas is by plasma enhanced chemical vapor deposition, low pressure chemical vapor deposition, or rapid thermal chemical vapor deposition (col. 10, lines 14-58).

Re claim 13, wherein the silicon-containing gas is deposited by rapid thermal chemical vapor deposition (col. 5, lines 47-67) at about 500^{O}C. to about 700^{O}C (i.e., 600 ^{O}C, col. 10, lines 14-58)..

Re claim 14, wherein the dielectric material comprises silicon dioxide (col. 7, lines 49-55).

Re claim l 6, a method of forming a nitride barrier layer, comprising the steps of: exposing a dielectric material to a silicon-containing gas at a partial pressure of about 10^{-2} to about 10^{-7} Torr (i.e., 10^{-2} Torr, col. 11, lines 37-50) to nucleate the dielectric material 14/102 and form a layer of silicon 15/16/17/18/19/21/103/104 (figs. 6-10, 21-22, col. 10, lines 25-65); and exposing the silicon layer to a nitrogen-containing gas to form a continuous silicon nitride barrier layer 106/107 (figs. 23-25; col. 16, lines 19-36) effective to inhibit passage of a dopant (note: inherently shows this because this is the intrinsic properties of the nitride material) into the dielectric material, see figs. 1-28 and cols. 1-22 for more details.

Re claim 17, a method of forming a nitride barrier layer, comprising the steps of: exposing a dielectric material 14/102 o a silicon-containing gas at a partial pressure of about 10^{-2} to about 10^{-7} Torr (i.e., 10^{-2} Torr, col. 11, lines 37-50), a temperature of about 500^{O}C. to about 700^{O}C. (i.e., 600 ^{O}C , col. 10, lines 35-58) and a duration of about 1 second to about 5 minutes (i.e., 30 seconds, col. 10, lines 35-58), to nucleate the dielectric material and form a layer of silicon 15/16/17/18/19/21/103/104 (figs. 6-10, 21-22, col. 10, lines 25-65); and exposing the silicon layer to a nitrogen-containing gas to form a continuous silicon nitride barrier layer 106/107 (figs. 23-25; col. 16, lines 19-36) effective to inhibit passage of a dopant (note: inherently shows this because this is the intrinsic properties of the nitride material) into the dielectric material, see figs. 1-28 and cols. 1-22 for more details.

Re claim 19, a method of forming a nitride barrier layer, comprising the steps of: depositing a silicon layer 15/16/17/18/19/21/103/104 (figs. 6-10, 21-22, col. 10, lines 25-65) onto a dielectric material 14/102 by exposing the dielectric material to a silicon-containing gas under low partial pressure, and exposing the silicon layer to a nitrogen-containing gas at a

temperature of about 700^{O}C. to about 900^{O}C. to nitridize the silicon layer (figs. 23-25; col. 16, lines 19-36) to form the nitride barrier layer, said barrier layer effective to inhibit passage of a dopant (note: inherently shows this because this is the intrinsic properties of the nitride material) into the dielectric material, see figs. 1-28 and cols. 1-22 for more details.

Re claim 104, wherein the step of exposing the silicon layer comprises a temperature of about 700^{O}C. to about 900^{O}C (col. 16, lines 19-37).

Re claim 112, wherein the step of exposing the dielectric material comprises a partial pressure of about 10^{-2} to about 10^{-7} Torr (i.e., 10^{-2} Torr, col. 11, lines 37-50), a temperature of about 500^{O}C. to about 700^{O}C. (i.e., 600 ^{O}C , col. 10, lines 35-58) and a duration of about 1 second to about 5 minutes (i.e., 30 seconds, col. 10, lines 35-58).

Therefore, the subject matter as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to select any suitable processing conditions, such as pressure, temperature, duration range as taught by Muralidhar in the method of Aronowitz et al. in order to form a barrier layer and optimize the processes.

Furthermore, the specification contains no disclosure of either the critical nature of the claimed process (i.e. the claimed pressure, temperature, and/or duration) or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen limitations or upon another variable recited in a claim, the Applicant must show that the chosen limitations are critical. *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990).

Furthermore, the processing conditions such as pressure, temperature, and/or duration range are considered to involve routine optimization while has been held to be within the level of

ordinary skill in the art. As noted in In re Aller, the selection of reaction parameters such as temperature and concentration would have been obvious:

> "Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed Acritical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."
>
> *In re Aller 105 USPQ233, 255 (CCPA 1955). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmscher 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).*

Therefore, one of ordinary skill in the requisite art at the time the invention was made would have used any pressure, temperature and/or duration range suitable to the method in process of Aronowitz in order to optimize the process.

With respect to claims 20-21, and 105; Aronowitz et al. and Muralidhar et al. disclosed above; however, both of them are silent to the flow rate and duration of the nitrogen-containing gas as required in claims 20-21 and 105. The claimed ranges of flow rate and time/duration, absent evidence of disclosure of criticality for the range giving unexpected results are considered to involve routine optimization while has been held to be within the level of ordinary skill in the

art. As noted in *In re Aller* 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955), the selection of reaction parameters such as flow rage, time/duration would have been obvious. *See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmscher 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).*

Therefore, the subject matter as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to select any suitable flow rate and exposing time in the method of Aronowitz et al. taken with Muralidhar in order to nitridize the silicon layer. Furthermore, the specification contains no disclosure of either the critical nature of the claimed process (i.e. the flow rate of 100-10000 sccm for about 1 second to about 180 minutes) or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen limitations or upon another variable recited in a claim, the Applicant must show that the chosen limitations are critical. *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990).

Response to Arguments

6. Applicant's arguments filed 7/30/2010 have been fully considered but they are not persuasive for reasons herein above.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jack Chen whose telephone number is (571)272-1689. The examiner can normally be reached on Monday-Friday (8:00am-4:30pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Davienne N. Monbleau can be reached on (571)272-1945. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Jack Chen
Primary Examiner
Art Unit 2893

/Jack Chen/
Primary Examiner, Art Unit 2893